

Description of a new bathyal species of *Calliostoma* (Mollusca: Trochoidea: Calliostomatidae) from the Arafura seaway

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ABSTRACT

Calliostoma bellatrix n. sp. is described from depths of 250 to 400 metres depth in the seaway between northern Australia and the southern Indonesian archipelago, and extending into the eastern Indian Ocean. Its smooth shell, with flat sides to the whorls and an acutely angled periphery ornamented with a “double” nodulose keel, render it unique among Indo-Pacific calliostomes, and it may be the sister species to *C. schroederi* Clench and Aguayo from similar depths in the Caribbean Sea. Both *C. bellatrix* and *C. schroederi* clearly belong within the subgenus *Ampullotrochus* Monterosato.

KEYWORDS: Trochoidea, Calliostomatidae, new species, *Calliostoma bellatrix*, taxonomy, biogeography.

INTRODUCTION

Nine years ago, Wilson included two coloured illustrations of a distinctive, undescribed calliostome (i.e., a species of top shell in the family Calliostomatidae) to embellish the Introduction to his first volume on Australian marine shells (Wilson 1993: 20). However the species was neither named nor mentioned further in this book, presumably because of lack of material. Additional specimens of this species have now become available from vessels trawling for scampi (Crustacea: Nephropidae) in the Arafura seaway (i.e., the collective name for the Arafura and Timor Seas). In addition, two monographs have appeared dealing with the taxonomy of the family in the southwestern Pacific Ocean (Marshall 1995a,b), so that the species can now be described as new in *Calliostoma* (*Ampullotrochus*).

Calliostome shells are conical (shaped like a spinning top) as is generally characteristic for all trochoideans with an oblique aperture and all have an oblique angle where the relatively straight columella meets the lower section of the outer lip. The outer lip is generally not thickened and is never denticulate. There is generally a sharp peripheral demarcation, which may be reinforced with a thickened spiral cord, between the spire and the base of the shell. Spiral cords, either smooth or ornamented with regular nodules, are the predominant sculptural component on the exterior of the shell. The honeycomb-like microsculpture on the protoconch of the shell is a derived character diagnosing the family, as are the projecting papillae on the oral disc of the animal, the prominent pseudoproboscis, the cuticularised lining of the buccal

cavity, and the radular structure and ontogeny. The radula (in all genera except *Fautrix*) contains an elongate rachidian (central) tooth with numerous fine denticulations plus numerous lateral teeth that are all finely denticulate. Both the rachidian and the laterals have the blade set at an acute angle from the broad, thin, flat basal plate. The innermost marginal tooth is enlarged as a heavy, hooked, laterally flattened element (Hickman and McLean 1990; Hickman 1998). Warén (1990) demonstrated the ontogeny of the radula, in which, uniquely within the Trochoidea, the lateral teeth arise through intercalation within the central field rather than by the usual vetigastropod transformation of marginal teeth into laterals.

All these apomorphies clearly demonstrate the monophyly of the Calliostomatidae. Therefore, on phylogenetic grounds, I follow Marshall (1995a,b) in treating it as a family, instead of a subfamily of the Trochidae, as has been taxonomic practice since Thiele (1929), certainly in modern Australasian literature (e.g., Powell 1979; Marshall 1979, 1988, 1994, 1985a; Wilson 1993; Hickman 1998; Wilson 1993; Spencer and Willan 1996). Recognition of the Calliostomatidae as a monophyletic family distinct from the Trochidae *sensu lato*, does not however render the latter monophyletic, so placement of the calliostomes cannot yet be considered settled. Marshall (1995b: 384) predicted resolution of phylogenetic groups within the Calliostomatidae would be “extremely and unusually difficult” and the description of this new species vindicates his prediction. Many of the species are uncommon or rare, and the majority are from deep water, so a comprehensive genetics study is unlikely for a long time to come.

The family Calliostomatidae comprises about 250 Recent species (Marshall 1995b). An austral centre of calliostome biodiversity has long been considered because of the high diversity of the group in New Zealand and Australian waters. Marshall's (1995a) recent monograph of the New Zealand fauna, wherein 33 endemic species of this group are recorded, has strongly reinforced that impression. The Australian calliostome fauna contains more than the 24 species recorded by Wilson (1993) (Marshall pers. comm., August 2002). Not a single calliostome species is common to both New Zealand and Australia. It now seems that the centre of biodiversity is actually in the wider southwestern Pacific Ocean, rather than strictly in the Australia-New Zealand continental regions, because Marshall (1995b) recorded 30 species from New Caledonia, the Loyalty Islands and the northern Lord Howe Rise and Spencer *et al.* (in press) list 40 species from the New Zealand Exclusive Economic Zone (i.e., the New Zealand shelf plus Kermadec Ridge).

The present new species was certainly not described by Schepman (1908) in the *Siboga* Expedition report, although his samples were from the same area and depth.

Coding for spiral cords on shells follows Marshall (1995b: Fig. 1), wherein P = primary spiral cords and S = secondary spiral cords. These cords are numbered in series from the upper (apical) suture. Height precedes diameter (herein termed 'width') in all given dimensions. All shell measurements were made on the shell's longitudinal axis, or at right angles to it. Abbreviations for institutions cited here are: MNZ, Museum of New Zealand Te Papa Tongarewa, Wellington; NTM, Museum and Art Gallery of the Northern Territory, Darwin; WAM, Western Australian Museum, Perth.

SYSTEMATICS

Calliostoma bellatrix, new species

(Figs 1A–F, 2)

Type material. HOLOTYPE - NTM P17143 (height 28.2 mm, width 31.7 mm, 9 teleoconch whorls, live), Arafura Sea, SE of Pulau Yamdena, Tanimbar Islands, 260–300 m depth, March 2001, coll. G.A. Cheeseman on *FV Fukui Maru*, c. 08°00'S, 132°00'E (Fig. 1A,B). PARATYPE - NTM P20242 (height 26.9 mm, width

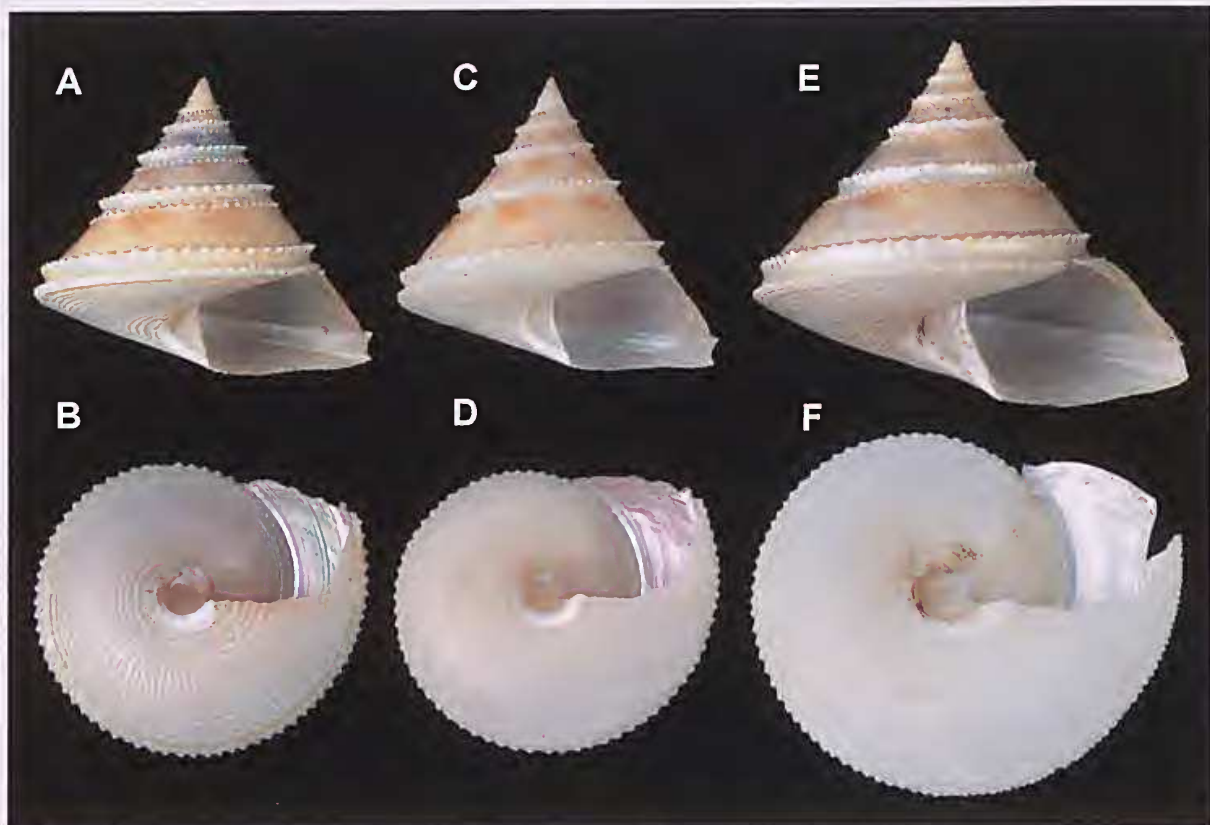


Fig. 1. *Calliostoma bellatrix* n. sp. A, B, holotype, NTM P17143, height 28.2 mm, width 31.7 mm, Arafura Sea, SE of Pulau Yamdena, Tanimbar Islands, 260–300 m depth; C, D, paratype, NTM P20242, height 26.9 mm, width 30.4 mm, Timor Sea, SE of Pulau Roti, Timor, 250 m depth; E, F, WAM S14251, height 33.6 mm, width 40.9 mm, off Rowley Shoals, 400 m depth.

30.4 mm, 8.5 teleoconch whorls, live), Timor Sea, SE of Pulau Roti, Timor, 250 m depth, 14 April 2002, coll. G.A. Cheeseman on *FV Orion*, c. 12°00'S, 124°00'E (Fig. 1C,D).

Additional material examined (non-type material). WAM S14252 (2 shells: specimen 1 live – height 27.2 mm, width 30.6 mm, 9 teleoconch whorls; specimen 2 dead – height 30.1 mm, width 27.9 mm, 9 teleoconch whorls), Arafura Sea, N of Darwin, 300 m depth, pre May 1988, coll. unknown, 11°05'S, 132°14'E; MNZ M.273186 (height 27.4 mm, width 32.4 mm, 9 teleoconch whorls, live), Arafura Sea, off Tanimbar Islands, 300 m depth, 1998, coll. unknown; WAM S14251 (height 33.6 mm, width 40.9 mm, 9.5 teleoconch whorls, live), off Rowley Shoals, 400 m depth, pre April 1986, coll. J. Rinkens, 17°20'S, 119°10'E (Fig. 1E,F) (= specimen illustrated by Wilson (1993: 20), but outer lip now broken).

Description. Based on shells of six specimens listed above (animal unknown). Shell up to 40.9 mm high, broader than high, aperture 44 % height of spire, glossy, fragile, outer shell layer very thin, spire evenly conical to colococonid in profile, mean spire angle 71.2° (range 66° to 82°), sides of whorls straight, periphery angulate, anomphalous.

Colour of protoconch and first 5 teleoconch whorls uniform cream, weakly nacreous; 6th and subsequent teleoconch whorls pink-buff (golden-apricot when live), nacreous (due to transparency of extremely thin outer shell layer), with broad, brown, opisthocline blotches or flames, strongest at suture, generally not extending beyond middle of whorl and never extending to periphery, spiral rows of nodules uniformly pale cream to almost white, rarely maculated with pale brown; base paler than top of shell, cream-buff; inner shell layer pink and nacreous; periostracum absent.

Protoconch consisting of 1 whorl, 0.45 mm wide, tightly coiled, evenly rounded, with honeycomb-like microsculpture, terminating in a distinct varix; very fragile – lost (through dissolution or dehiscence) in four of the specimens.

Teleoconch with average of 9 (range 8.5 to 9.5) whorls, but sutures very indistinct. First 0.25 whorl rounded, with 3 primary rows of spiral cords (P3 strongest, P2 weaker, P1 weakest). Remaining 0.75 of first whorl plus next 2 whorls with flattened sides and sculptured with 3 primary rows of sharp, strongly nodulose spiral cords (P3 strongest, P1 weaker, P2 weakest), nodules in rows on cords and interconnected between rows by strong oblique axial costae; costae commence on P1 (i.e., not at upper suture) and extend to lower suture without diminution. P2 and axial ribs rapidly weaken on whorls 3 and 4, so that P2 is merely a low, rounded thread on whorl 4. Both P2 and axial ribs totally absent on whorl 5 and all subsequent whorls. Whorls 5 to 9 straight sided (to slightly convex see below); S3 (there being no S1 or S2) first detectable on

whorl 5 as a series of weak nodules at lower suture, rapidly increasing to narrow, sharp (but unthickened), nodulose spiral cord at peripheral angle equal in strength to P3. All whorls subsequent to 5, have P1 as a series of rounded nodules at upper suture, an extensive, macroscopically smooth (actually with up to 10, microscopic, narrow, rounded, additional spiral cords) intervening section (without any trace of P2), P3 as a series of (approximately 60) very strong, sharp nodules immediately above periphery, and S3 as a series of nodules at periphery equal in strength to P1. Prominence of P3 and S3 on periphery impart a distinctive “double-keeled” appearance to acute angled periphery of shell. Ontogeny of sculptural elements illustrated in Figure 2. Base flat, with 15–19, sharp-sided weakly nodulose spiral cords, decreasing in strength inwards from periphery, and interconnected by microscopic oblique radial threads; narrow central zone usually smooth (see below); innermost section with 3 or 4 rows of moderately strong nodulose spiral cords and a broad, white, thickened cord flanking infilled umbilical depression. Aperture oblique, subquadrate, acutely angled at periphery, obtusely angled abapically where columella meets lower section of outer lip. Outer lip very thin at rim (broken in all specimens), not thickened anywhere.

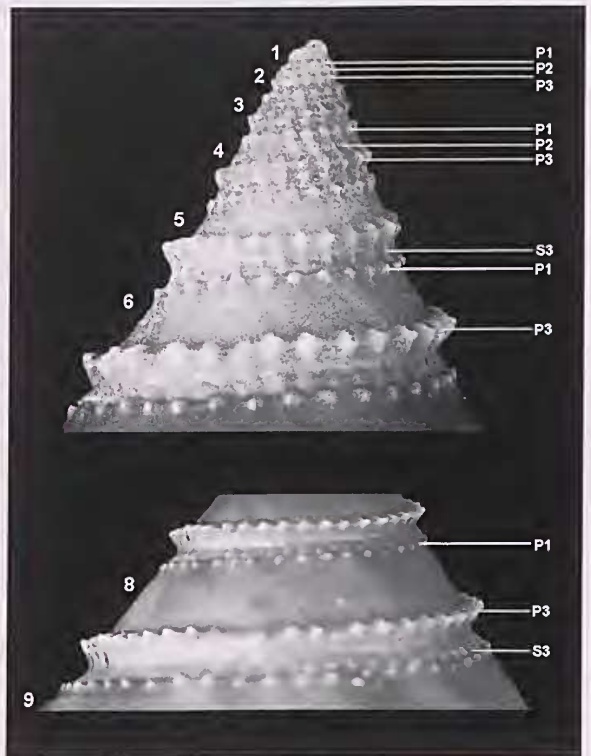


Fig. 2. *Calliostoma bellatrix* n. sp. Composite diagram to illustrate ontogeny of sculpture on teleoconch whorls on a single shell, WAM S14252, height 27.2 mm, width 30.6 mm, Arafura Sea, N of Darwin, 300 m depth. Whorls numbered on left and spiral cords indicated on right.

Inner lip a convex, spreading glaze over entire columella. Operculum (retained in only NTM P20242) circular, multispiral, pale brown, transparent, sculptured with very fine radial threads.

Distribution. *Calliostoma bellatrix* is now known to occur in a wide arc in the seaway between northern Australia and the southern Indonesian archipelago – from the Arafura Sea north of Darwin, through the Timor Sea, westwards to west of the Rowley Shoals off northern Western Australia. It lives off the continental shelf between 250 and 400 m in depth.

Judging by the specimens brought in by the scampi trawlers, the dominant benthic species co-occurring with *Calliostoma bellatrix* in these soft bottom, bathyal communities are the bivalves *Acesta rathbuni* (Bartsch) (Limidae) and the crustaceans *Tisea grandis* Morgan and Forest (Diogenidae), *Chaceon* sp. (Geryonidae), *Neolithodes* sp. (Lithodidae), *Platymaia* (Majidae) and *Metanephrops* sp. (Nephropidae).

Remarks. *Calliostoma bellatrix* is distinguished from all the other described calliostomes by the combination of its thin shell, flat-sided whorls, complete suppression of P2 to render the central section of the whorls (macroscopically) smooth, presence of only a single secondary spiral cord (S3, on the periphery) which, together with P3, produce a sharp nodulose (almost spined) “double” keeled appearance to the area in the vicinity of the acutely angled periphery, pinkish inner laminar nacreous layer, extremely thin (transparent) outer prismatic layer with colour pattern of brown axial markings confined to the upper half of each whorl.

The number of spiral cords on the base is the character that varies most intraspecifically; four of the shells having a narrow smooth central zone whereas, in two others (WAM S14251 and S14252b), spiral cords cover the entire base (18 and 19 respectively). This character varies independently of location, but another character (spire angle) apparently varies geographically. Shells from the north of the range have a relatively narrow spire angle (69° to 72°) that does not change with age (Fig. 1A–D), whereas those from the west of the range have a relatively broader spire angle (82°) resulting from the last adult whorl expanding more rapidly than previous whorls to give a cocloconid profile overall (Fig. 1E,F).

Calliostoma bellatrix clearly belongs in the subgenus *Ampullotrochms* Monterosato (*sensu* Marshall 1995b) because of its narrowly conical shell, acutely angled periphery, lack of umbilicus, P1–P3 commencing on the first teleoconch whorl, and the strongly flattened and strongly nodulose early teleoconch whorls that bear strong interconnecting axial costae. Three species in

that subgenus appear closest to *C. bellatrix* conchologically – *C. schroederi* Clench and Aguayo, *C. iris* Kuroda and Habe, and *C. heros* Marshall. Most similar, perhaps the Caribbean counterpart (cognate) species of *C. bellatrix*, is *C. schroederi* Clench and Aguayo, 1938 from 320 to 460 metres depth off the Bahamas and Cuba. That species was redescribed by Clench and Turner (1960) and placed in the subgenus *Kombologion*. It appears uniformly silvery nacreous but is ivory white, with 4 to 5, thread-like, yellow bands above and below the periphery (pinkish nacreous and axially flamed or blotched in *C. bellatrix*), the periphery is less acutely angulate so the aperture is more circular, there is a weaker cord (?S2) between P3 and S3 on the body whorl and the base is smooth except for a few fine spiral threads around the columellar area. The shell of *C. iris*, which is known from 150 to 250 m depth off southern Japan, is more narrowly conical (mean spire angle 52°), with relatively strong spiral cords in the central section of the later teleoconch whorls (smooth in *C. bellatrix*), and strong and regular brown maculations on the periphery signifying the maximum development of the axial lines (markings confined to the upper half of the whorls in *C. bellatrix*). The shell of *C. heros*, from 255 to 425 m off the Loyalty Islands, has a narrow umbilicus, P3 is maculated with yellowish brown and white, and there are numerous spiral cords on all the spire whorls as well as the base.

Calliostoma (Bathyauctor) coriolis Marshall, from 630 to 705 metres off Chesterfield Reef and Lansdowne Bank, is superficially similar to *C. bellatrix* in having an acute “double” peripheral keel and obsolete spiral sculpture on the central sections of its teleoconch whorls. However this keel is actually composed of S3 plus P4 (P3 plus S3 in *C. bellatrix*) and the shell is more narrowly conical (mean spire angle 56°), uniformly white, and very narrowly umbilicate.

Etymology. The specific name recalls the bright star Bellatrix in the constellation of Orion, the Great Hunter. The specific name is intended as a noun in apposition to the generic name and so is indeclinable.

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REFERENCES

- Clench, W.J. and Aguayo, C.G. 1938. Notes and descriptions of new species of *Calliostoma*, *Gaza* and *Columbarium* (Mollusca); obtained by the Harvard-Habana Expedition off the coast of Cuba. *Memorias de la Sociedad Cubana de Historia Natural* **12**: 375–384, pl. 28.
- Clench, W.J. and Turner, R.D. 1960. The genus *Calliostoma* in the Western Atlantic. *Johnsonia* **4** (40): 1–80.
- Hickman, C.S. 1998. Superfamily Trochoidea. In: Beesley, P.L., Ross, G.J.B. and Wells, A.E. (eds) *Mollusca: The Southern Synthesis. Fauna of Australia. Volume 5*. Pp. 671–692. CSIRO Publishing: Melbourne.
- Hickman, C.S. and McLean, J.H. 1990. *Systematic revision and suprageneric classification of trochacean gastropods*. Natural History Museum of Los Angeles County Science Series Number 35: Los Angeles.
- Marshall, B.A. 1979. The Trochidae and Turbinidae of the Kermadec Ridge (Mollusca: Gastropoda). *New Zealand Journal of Zoology* **6**: 521–552.
- Marshall, B.A. 1988. Thysanodontinae: a new subfamily of the Trochidae (Gastropoda). *Journal of Molluscan Studies* **54**: 249–282.
- Marshall, B.A. 1994. A new species of *Calliostoma* from New Zealand. *Molluscan Research* **15**: 67–69.
- Marshall, B.A. 1995a. A revision of the Recent *Calliostoma* species of New Zealand. *The Nautilus* **108**: 83–127. [Publication date 11 May 1995]
- Marshall, B.A. 1995b. Calliostomatidae (Gastropoda: Trochoidea) from New Caledonia, the Loyalty Islands, and the northern Lord Howe Rise. In: Bouchet, P. (ed.) Résultats des campagnes MUSORSTOM, volume 14. *Mémoires du muséum national d'histoire naturelle* **167**. Pp 381–458. Editions du Muséum national d'Histoire naturelle: Paris. [Publication date 29 December 1995]
- Powell, A.W.B. 1979. *New Zealand Mollusca: marine land and freshwater shells*. Collins: Auckland.
- Schepman, M.M. 1908. The Prosobranchia of the Siboga Expedition, Part I: Rhipidoglossa and Docoglossa with an Appendix by Prof. R. Bergh. *Siboga-Expeditie* **49c**: 1–107.
- Spencer, H.G. and Willan, R.C. 1996. *The marine fauna of New Zealand: index to the fauna 3. Mollusca*. New Zealand Oceanographic Institute Memoir 105: 125 pp. National Institute of Water and Atmospheric Research Ltd: Wellington. [Publication date February 1996, not 1995 as stated on title page]
- Spencer, H.J., Marshall, B.A. and Willan, R.C. In press. Spencer, H.G., B.A. Marshall & Willan, R.C. Phylum Mollusca – recent chitons, clams, snails, slugs, squids and octopuses. In: Gordon, D.P. (ed.) *The New Zealand Inventory of Biodiversity: A Species 2000 Symposium Review*. University of Canterbury Press, Christchurch.
- Thiele, J. 1929. *Handbuch der systematischen weichtierkunde. Erster Band. Teil I. (Loricata; Gastropoda; Prosobranchia)*. Gustav Fisher Verlag: Jena. Pp. 1–376 [Dated “1931” but actually published between 4 September and 22 October 1929]
- Warén, A. 1990. Ontogenetic changes in the trochoidean (archaeogastropod) radula, with some phylogenetic interpretations. *Zoologica Scripta* **19**: 179–187.
- Wilson, B.R. 1993. *Australian marine shells prosobranch gastropods part one*. Odyssey: Kallaroo, Western Australia.

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